MRR-2

Micro Rain RADAR

User Manual

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1 Safety Precautions

To operate the MRR-2 a mains voltage of 210-240 VAC is needed for the power supply. An improper handling can be dangerous to you. Only competent and instructed persons should work with this system or with parts of it.
The outdoor installation must not be performed in case of an approaching thunderstorm, to avoid a possibly endangering of personnel by lightning.

There are not known any health hazards originating from the emitted electromagnetic radiation of about 50 mW. Nevertheless you should take care that everybody keeps out of the beam above the antenna (parabolic dish) when it is in operation.

All connecting cables, plugs, and couplings of the MRR-2 are not interchangeable to prevent any erroneous assembly. This safety precaution is disabled if other types of plugs are installed by the user. Therefore any guarantee explicitly expires and METEK accepts no responsibility for injuries to persons, damage of equipment or other consequences connected with not authorized changing of connectors, cables or other parts of the system.

Depending on regional rules for the use of electromagnetic transmitters frequency permission might be necessary. The operator of the system will be liable for the achievement of such permission. However METEK will be of help with providing adequate information. Copies of the certifications for Germany can be found in chapter 6 of this manual.

2 How to use this manual

The delivered hardware items are described in section 4. Make sure that the delivery is complete and free of damage. Consult section 5 for setting up the hardware. In section 6 the installation and use of the control software is described. The technical specifications are listed in section 8.

Section 7 contains more detailed information which is not needed for standard operation.

All auxiliary information marked by a grey vertical line on the left margin may be skipped at first reading as it is not needed for standard setting up and operation.

3 Measuring Principle

The Micro Rain Radar MRR-2 retrieves quantitative rain rates, drop size distributions, radar reflectivity, fall velocity of hydro meteors and other rain parameters simultaneously on vertical profiles up to several kilometers above the radar.

It operates with electromagnetic radiation at a frequency of 24 GHz with a modulation of 0.5 – 15 MHz according to the height resolution (e.g. 300 m – 10 m). The radiation is transmitted vertically into the atmosphere where a small portion is scattered back to the antenna from rain drops or other forms of precipitation.

Due to the falling velocity of the rain drops antenna there is a frequency deviation between the transmitted and the received signal (Doppler frequency). This frequency is a measure for the falling velocity of the rain drops. Since drops with different diameters have different falling velocities the backscattered signal consists of a distribution of different Doppler frequencies. The spectral analysis of the received signal yields a power spectrum which is spread over a range of frequencies lines corresponding to the Doppler frequencies of the signal.

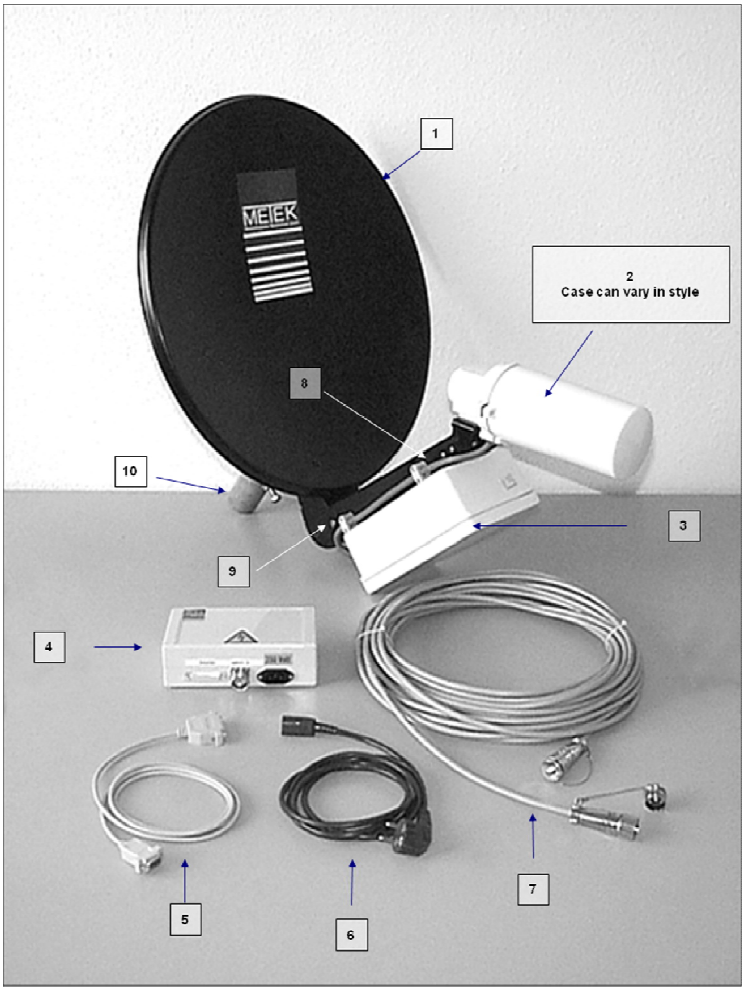
The RCPD determines this power spectrum with a high time resolution (25 per second) and sends mean power spectra every 10 s to the connected control and data acquisition system, where the reflectivity spectrum is calculated considering the calibration parameters of the RADAR module. Using known relations between fall velocity, rain drop size and scattering cross section the drop spectrum (or drop size distribution) is derived. The integration over the entire drop size distribution, considering further correction terms, followed by further averaging over 10 to 3600 seconds, results in rain rate and liquid water content.

The output signal of the RADAR is transmitted continuously (CW mode), a linearly decreasing saw tooth modulation of the transmit signal (FM mode) makes it possible to perform profile measurements with selectable range resolution.

The RADAR antenna is an offset parabolic dish with vertical beam orientation. This antenna design allows rainwater to drain without building ponds. In order to avoid disturbances from snow, which could cover the antenna dish, optional antenna heating is offered.

4 System Description

4.1 Overview



1. Parabolic Dish,
2. Transceiver,
3. RCPD,
4. Junction Box,
5. Cable Junction Box-PC,
6. AC Power Cable,
7. Cable RCPD-Junction Box,
8. Antenna Arm,
9. Pivot,
10. Tube Socket

Figure 1 Components of the System

The Control- and Evaluation Computer, a commercial PC, (not part of delivery) must be ordered separately. The operating system must be Windows® 2000 or XP. (Windows® Vista and Windows 7 is not supported).

4.2 Description of the Components

4.2.1 Parabolic Dish

The antenna is used for the transmission of the RADAR signals and the receiving of backscattered signals. It is designed as an offset parabolic dish (1). Its largest diameter is 70 cm, the beam width is 2°. Due to the offset-design of the parabolic dish rainwater can drain off.

For antenna mounting the tube socket (10) (inner Ø = 49.4 mm, outer Ø = 54.4 mm) is to be plugged onto a pole with an outer diameter of max. 49 mm. The socket is fastened with an M10 screw (10 mm Ø).
Connect a ground wire to this screw which serves as a surge protector.

The pivot (9) is factory-adjusted, so that vertical orientation of the mounting tube socket results in a vertical orientation of the antenna beam. (Ignore the scale on the pivot).

The parabolic dish must not be moved in its pivot (9), because this would cause beam deviations from vertical and would result in erroneous measurements.

The transmitting and receiving properties of the antenna affect the radar calibration. Therefore the reflector surface should be clean (e.g. free from leaves or wet snow). For the same reason any mechanical deformation of the parabolic dish must be avoided. If nevertheless obvious deformation occurred, the reflector must be replaced.

4.2.2 Antenna Heating (Option)

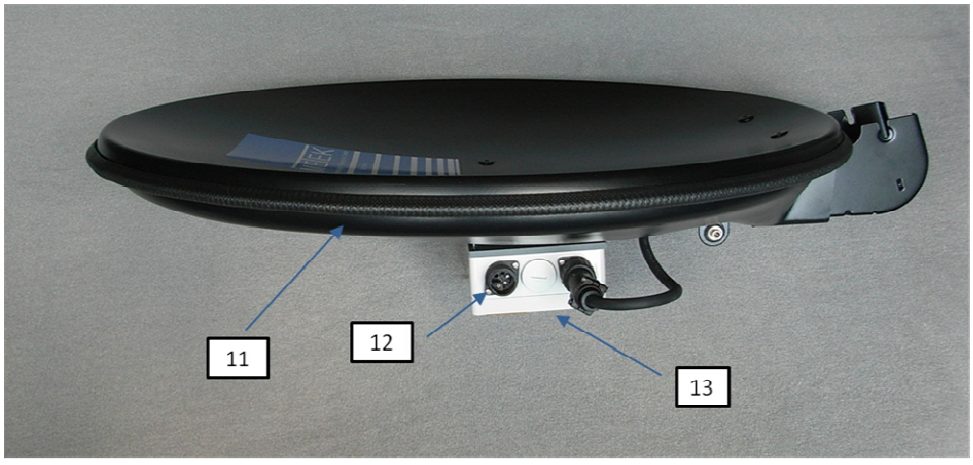


Figure 2 Antenna Heating

The back side of the reflector is optionally equipped with a heating coil. It is covered and sealed with a molded lid (11) which provides also extra stability for the reflector. The energy consumption increases with decreasing temperatures and amounts to maximum 500 W. The heating is activated when the temperature falls below a threshold which can be adjusted in the heating-junction box (13). The heating coil works with 230 VAC voltage supply and needs an extra power cable which is connected to (1).

4.2.3 RADAR Control and Processing Device and Transceiver

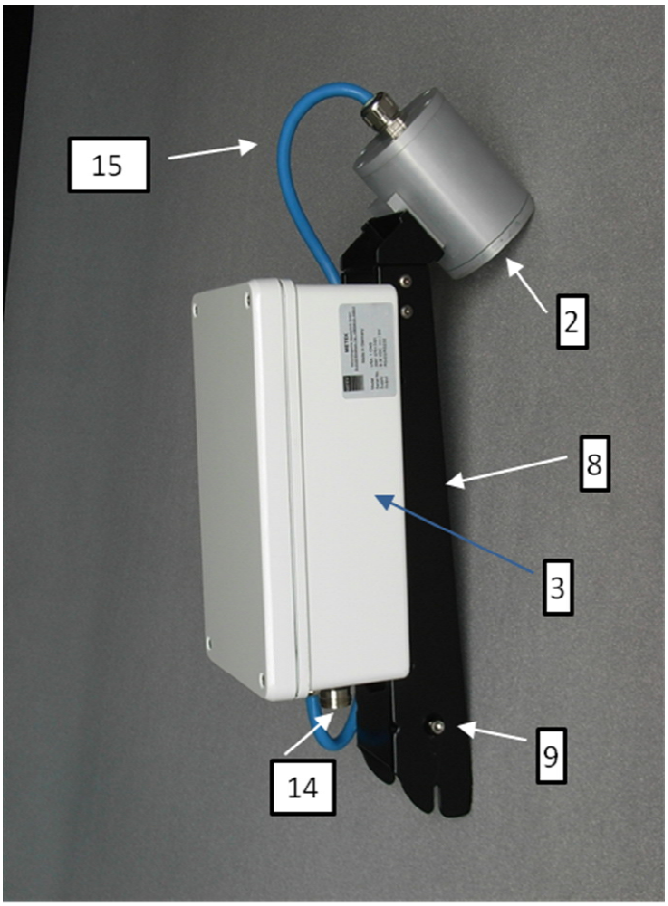


Figure 3 RCPD and Transceiver

The RCPD (3) generates the RADAR transmit modulation signal and passes it to the transceiver (2) through cable (15). It analyses the back-scattered receiver signal, calculates Doppler spectra and transfers average power spectra (referred to as “raw data”) to the control and evaluation PC, where these spectra are interpreted. The RCPD is located in a water protected IP65 housing, which is fixed to the antenna arm (8). At the bottom side of the RCPD is the socket (14) for cable (7). The electronic components inside the housing don’t need any service. As far as possible the RCPD should not be opened by the user.

4.2.4 Junction Box / Power Supply

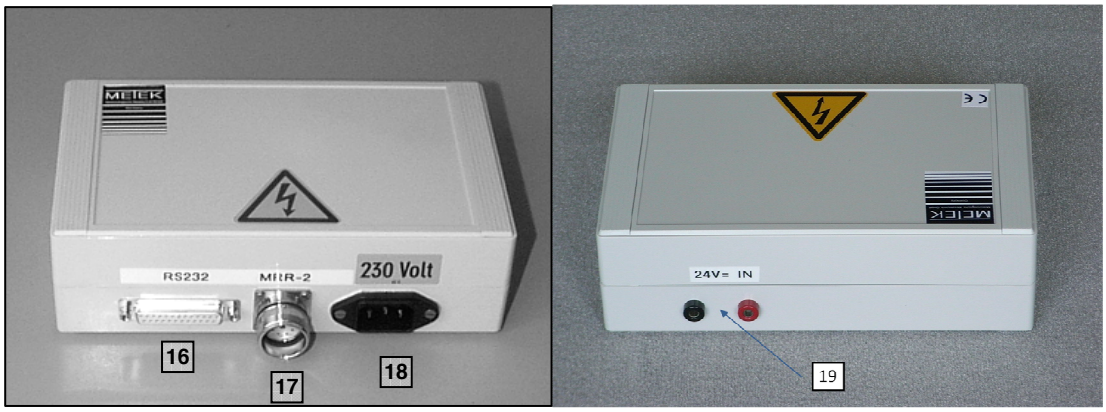


Figure 4 Junction Box Left:Front Side, Right: Back Side

The junction box is used to pass through the communication between the PC and the RCPD. For this purpose it has a 25-pin D-sub-miniature socket, (16) for the data cable (5) to the PC and a flanged socket (17) for the cable (7) to the RADAR RCPD (3).

The power supply for the RCPD and Transceiver is also integrated in the junction box. An IEC connector for the mains supply of 230 VAC (17) is on the front side of the case. On the back side are two sockets for banana plugs for the connection of an alternative external DC power supply (19). The power supply (24 VDC) for the RCPD and Transceiver is also passed through cable (7).

Note : The junction box is not appropriate for outdoor operation.

4.2.5 Cable RCPD-Junction Box

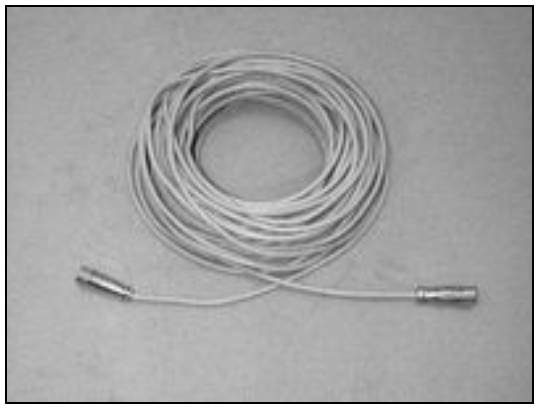


Figure 5 Cable between Junction Box and RCPD

The cable has a length of 25 m, on both ends are screwed plugs (male and female respectively). They must be screwed onto the matching plugs at the junction box (cable has pins) and at the RCPD (cable has sockets).

4.2.6 Cable Junction Box-PC

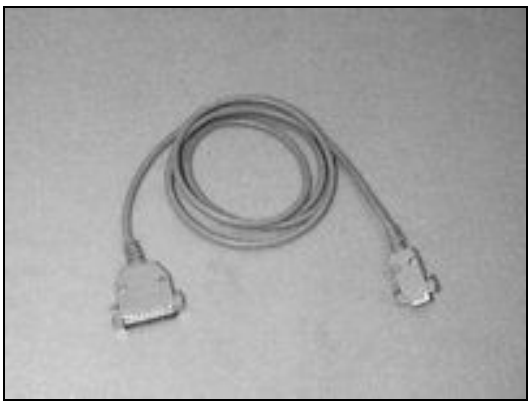


Figure 6 Cable Junction Box-PC

Data cable with a 9-pin (female) and a 25-pin (male) plug and a length of 1.5 m is delivered. This cable is not appropriate for outdoor applications.

4.2.7 Control- and Evaluation Computer (PC)

A personal computer (PC) with the operating system Windows® 2000 or XP serves for setting the operation parameters and data evaluation of the MRR. (Windows® Vista and Windows® 7 are not supported).

The PC must have at least one serial port which will be configured by the control program as follows:

57600 baud,
8 data bits, no parity,
software protocol (XON/XOFF), no hardware protocol (handshake).

Pinning (D-Sub-25-socket at the device) :

Pin 2	RD	*received data*	to the device
Pin 3	TD	*transmitted data*	from the device
Pin 7	GND	*ground*	

The control program which is needed to operate the MRR-2 is part of delivery. Its installation and operation is described in section 6 *Control Program* page 16.

5 Hardware Installation

5.1 General Provisions

- Before you start the system, all cable connections must be set up.
- Only the antenna unit including RCPD, Transceiver and cable (7) are designed for outdoor operation. All other components, e.g. the junction box and PC, must be installed in a weather protected environment with temperatures within 5 - 50 °C.
- The electronic cases may be opened only in dry environment. Especially in outdoor area you risk damage by moisture.
- If cables are laid on free field, a cable conduit is recommended.
- All cable connections should be protected by strain-reliefs.
- Use only the original connectors. Guarantee is void, if other connectors are installed.

5.2 Site Conditions

Before actual installation the site must be checked for its suitability for rain measurements.

There must be free view of at least 10° zenith angle over the radar.

Nearby transmitters (base stations of mobile phones, broadcast towers, radars) can cause interference although they operate nominally at different frequency bands. If such neighborhood is necessary, a simple metallic screen or larger object (container) obscuring the direct line of sight to the interfering source can help.

The vicinity of electric machines (e.g. drive of elevators) should be avoided, since they can create interfering signals which are difficult to screen.

If measurements at very low heights are planned, (with appropriate settings the MRR-2 allows measurements from a minimum height of 20 m above ground) take care that the wind field in this level is not disturbed by nearby buildings, trees, masts etc., because strong turbulence could falsify the data.

In contrast with in-situ rain sensors the exposure of the antenna to the free wind field is not detrimental but favorable.

Figure 7 shows various examples of MRR installations: On ground, on top of containers and on top of buildings.

Figure 7 Examples of MRR installations

5.3 Installation Procedure

Preparations:
A fixed vertical pole (Ø max. 49 mm, length min. 30 cm) is required for attaching the antenna. Operating of the MRR-2 requires a 230 VAC mains supply, with a fuse protection of 8 A (slow) minimum. To prevent disturbance of the device by variations or breaks of the power supply we recommend the use of a no-break power supply (UPS).

Required Tools: A wrench with 17 mm opening.

Installation Steps:

1. Install the control and evaluation computer (PC) according to the documents of the manufacturer.
2. Plug the tube socket (10) of the RADAR antenna over the attachment pole and clamp it with the M10 fixing bolt.
3. Check the vertical alignment of the antenna with the built in bubble level (see Figure 8)

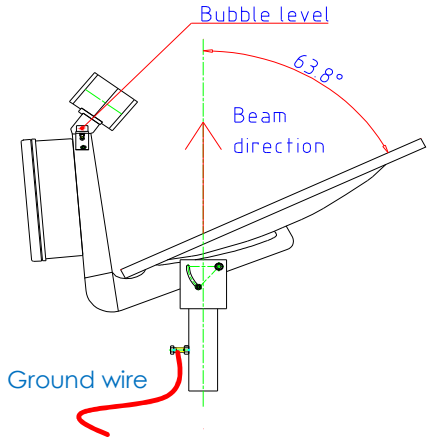


Figure 8 Vertical alignmet of the radar beam

4. Attach a ground wire to the fixing bolt for lightning protection.
5. Connect cable (7) between RCPD and Junction Box after mounting of the antenna.
6. Connect cable (5) to that serial interface of the computer, which was selected in the operating system for the connection of the MRR-2. If this serial port is unknown, it can be looked up in the administration of the "services" in the operating system of the computer and it can be changed accordingly there. See also installation of the control program page 16 ff.
7. Connect cable (6) of the Junction Box to the mains voltage of 230 VAC (cable (6)).
8. Establish the communication between the control program „MRR-2 Control" and the RCPD-firmware.
9. Check the correct data transmission and recording.

6 Control Program

If the PC for controlling the MRR-2 with was not ordered separately the programs for controlling the MRR-2 and for data recording are delivered on a CD-ROM and must be installed on a PC with operating system **Windows® 2000 or Windows® XP.** (Older Windows® versions, Windows® Vista, or Windows® 7 are not supported.)

If the PC was configured and delivered by METEK (optional) 6.1 **Installation** may be skipped.

6.1 Installation

For installing the Control Program:

- Insert the CD-ROM.
- Login as administrator.
- Open the program group `my computer` (icon on the desktop).
- Open the folder for the CD-ROM device.
- Change to the folder `METEK\MrrCtrl.`
- With the right mouse key click on the file `Mrr`***`XXXXXX`***`.inf`.
- Activate the install menu. The files are copied and the registry of the PC is updated.
- When the copy process has finished, reboot the PC.

Note: The data flow rate from the MRR to the PC requires that the PC response time does not exceed certain limits. If the PC was configured and delivered by METEK (optional), meeting of this request is warranted. Any modern PC with medium performance is basically sufficient to run the Control Program without flaws, if there are not too many other tasks running simultaneously. Particularly virus scanning programs may slow down the PC below the minimum possible value. In that case the data records are corrupted. Check the integrity of recorded data by visual inspection or by some automated procedure.

6.2 Using the Control Program

After login to the operating system open a command line window and enter the command `MrrCtrl.exe.` The following dialogue window appears (The screenshots in this manual were taken from a Windows® 2000 system.):

Figure 9 Login Screen

If you are sitting at the PC which is directly connected to the MRR-2 leave the entry at ***Name of the Remote PC*** empty (or type a period or the name of the local PC). If you are sitting at another PC, enter the name of that PC to which the MRR-2 is connected directly and where the communication service (`MrrCtrl.exe`) was started.
The User Name is generated automatically and the Password is usually not needed (see below for exceptions).

The ***Password*** entry field is useful if the remote computer is a member of another Windows domain, because in this case a connection can be built up only if a user name and the matching password is given. The user name is set automatically (see the header of the dialog window).

The network connection to the remote computer usually is a LAN- or a RAS connection. RAS connections using the public telephone net are mostly not very efficient, especially connections with mobile phone radio nets. Considering that, the login dialog provides the use of time-out-values which are adjusted to the maximum delay times for the responses from the remote PC. Using a direct LAN or a local login, this feature is not needed.

If the program was started by a command line input, the information concerning the login window can be handed over as a parameter. Example:

```
C:\METEK\MrrCtrl hostname secret /t
```

This entry would try to build a connection to a computer with the name `\\hostname`. The password is `secret`, the time-out-values are set for slow WAN connections (`/t`). The parameter `/t` is optional, the computer name and the password however must be given always. This is also valid for local logins (the password will not be checked).

If the connection to the communication service could be built up, the entire status of the MRR-2 is read out first. This can take some seconds, on RAS connections even some minutes.

Click the OK button
The MRR-2 status is read out which takes some seconds (in case of slow remote communication even some minutes). Then the Main Menu will appear.

6.2.1 Main Menu

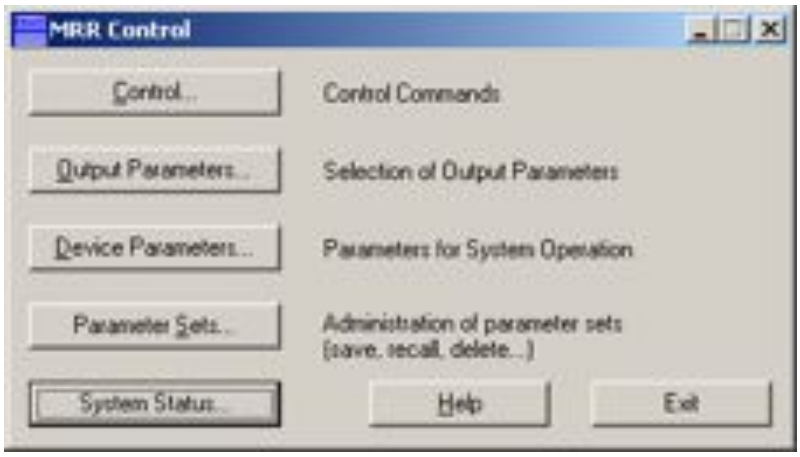


Figure 10 Main Menu

The main menu shows buttons for the menus

Control	chapter 6.2.2 on page 20
Output Parameters	chapter 6.2.3 on page 20
Device Parameters	chapter 6.2.4 on page 23
Parameter Sets	chapter 6.2.5 on page 24
System Status	chapter 6.2.6 on page 27

You can leave the program with the ***Exit*** button.
The ***Help*** button provides a Windows conforming help text.

6.2.2 Control Commands Menu

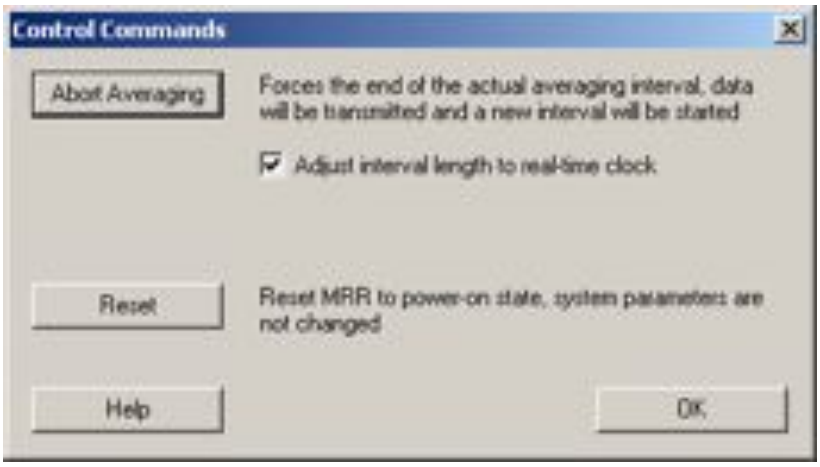

Control Commands
Abort Averaging
Forces the end of the actual averaging interval, data will be transmitted and a new interval will be started
Adjust interval length to real-time clock
Reset
Reset MRR to power-on state, system parameters are not changed
Help
OK

Figure 11 Control Commands

Abort Averaging

The current averaging interval is stopped. Data, collected since the begin of the averaging interval, are processed and a new averaging interval is started regardless of elapsed averaging time.

Adjust interval length to real time clock

This checkbox activates the synchronization of measuring intervals to the actual time of day. This means every output of averaged data will occur at 'round' times. Example:
If the measuring time has been set to 600 seconds, output will be generated at every full 10 min.

Reset

Pressing this button will perform a reset of the RCPD firmware. There is no influence on the MRR-2 parameters. It has the same effect as an interruption of the power supply.

6.2.3 Output Parameters Menu

Figure 12 Output Parameters

The two upper panels shown in Figure 12 contain check boxes for configuring selections of *averaged data* and *instantaneous data* separately for recording. *Instantaneous data* are processed on the basis of one raw spectrum[1]. *Averaged Data are processed* on the basis of an average of multiple raw spectra, depending on the selected averaging time. The selectable variables are described in the table below.

Selection of	**causes the recording of**
Height[2]	Measuring height above ground
Spectra	Spectral volume reflectivity
Drop Spectra	Drop diameter and number of drops per volume and diameter
Attenuation	Two way path integrated attenuation
Radar Reflectivity	Radar reflectivity factor and attenuated radar reflectivity factor
Rain Rate	Vertical volume flux of liquid water per unit area
Liquid Water Content	Mass of liquid water per volume
Falling Velocity	Doppler velocity (1. moment of the spectrum)

[1] Since the raw spectra and the instantaneous data represent already averages over 10 seconds, the term “instantaneous” must not be understood literally.
[2] The output variable*Height* should always be selected, as this facilitates further processing of recorded data.

Recording Options

Raw data

By checking “Record raw data” the raw spectra including metadata are written in addition to other selected data to a separate log-file. The path name of these log-files is defined by the parameters RawDataFile , RawDataPath.

Conditional recording

By checking “Record only if it rains” no data are recorded, if the evaluation software does not detect precipitation in any measuring height during the measuring (averaging) interval. This condition can be activated separately for averaged/instantaneous data and raw data respectively.

Measuring Height(s)

A subset of measuring heights can be selected for recording. This subset is used for both kinds of data output, instantaneous and averaged data. The selection of measuring heights for output is done with two lists containing the selected and unselected height steps. To move items (sets of height steps) between the lists they must be marked in the source list. The movement will be performed when the arrow button pointing to the other target list is pressed. (The *height resolution* (step-width) can be adjusted with the device parameters menu (see chapter 6.2.4 on page 23)).

Time Zone

The time zone can be selected which is used for the time stamps of the recorded data.

All changes in the Output Parameters Menu become effective by clicking the “Ok” button. Then the corresponding commands are transmitted to the RCPD firmware. Clicking the “Cancel” button cancels all changes.

6.2.4 Device Parameters Menu

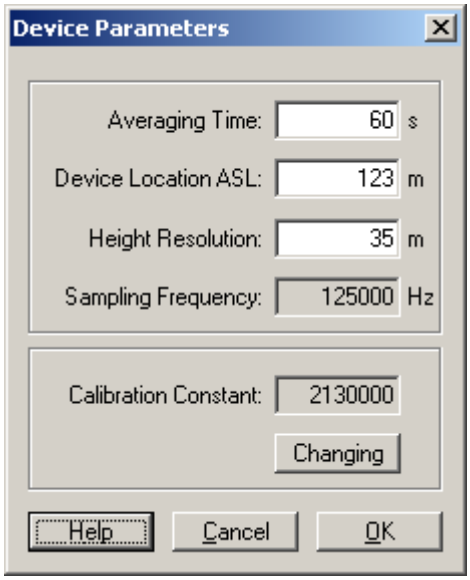


Figure 13 Operation Parameters

Averaging Time

Here you define the averaging time for the *averaged data*.
The adjustable range is 10 .. 3600 s

After each averaging time, an *averaged data* set is generated and recorded and a new averaging interval starts. Instantaneous data are generated and recorded independently in 10 s time intervals within each averaging interval.

Device Location ASL

Enter the height of the MRR-2 location above sea level.
The adjustable range is 0 ... 9999 m.
This parameter is used for the density correction of the fall speed versus drop size relation.

Height Resolution

Enter the desired distance between adjacent measuring heights (step width).
The adjustable range is 10 - 1000 m. Typical values are 30 – 100 m.
The measuring heights are integer multiples of the height resolution. The maximum number of height steps is 31.

Sampling Frequency

Number of samples per second of the analogue input signal of the MRR-2. This parameter can't be changed by the user.

Calibration Constant

This constant is needed for converting the engineering units of the receiver signal (raw data) into physical units (instantaneous and averaged data). See Physical Basis for details. The calibration constant is factory set. Nevertheless it can be changed by the experienced user. Before a new calibration constant can be entered the "changing" button must be pressed. It should be only done, if there is clear evidence for a miss-calibration of the MRR. This can be inferred for example from rain rates measured with the MRR (R_{MRR}) and a rain gauge (R_{RG}) respectively. If C_{old} is the old calibration constant, the new calibration constant C_{new} can be calculated according

$$C_{new} = C_{old} \frac{R_{RG}}{R_{MRR}}$$

It should be kept in mind that comparisons of rain rates measured aloft with the MRR and a rain gauge are not straightforward due to the strong inhomogeneity of rain. MRR data should be taken from range gates not below the 3rd range gate, because approximations in the radar equation cause larger biases at lower range gates. On the other hand the measuring height should not exceed 200 m in order to keep attenuation effects small (they are only eliminated in case of correct calibration) and to keep the correlation with surface precipitation at a useful level. Further make sure that the MRR rain retrieval is not affected by the ice phase or melting processes. Strong winds should also be avoided since rain gauges tend to unreliable under such conditions.

OK

All changes in the Device Parameters Menu become effective by clicking the "OK" button. Then the corresponding commands are transmitted to the RCPD firmware. Clicking the "Cancel" button cancels all changes.

6.2.5 Parameter Storage

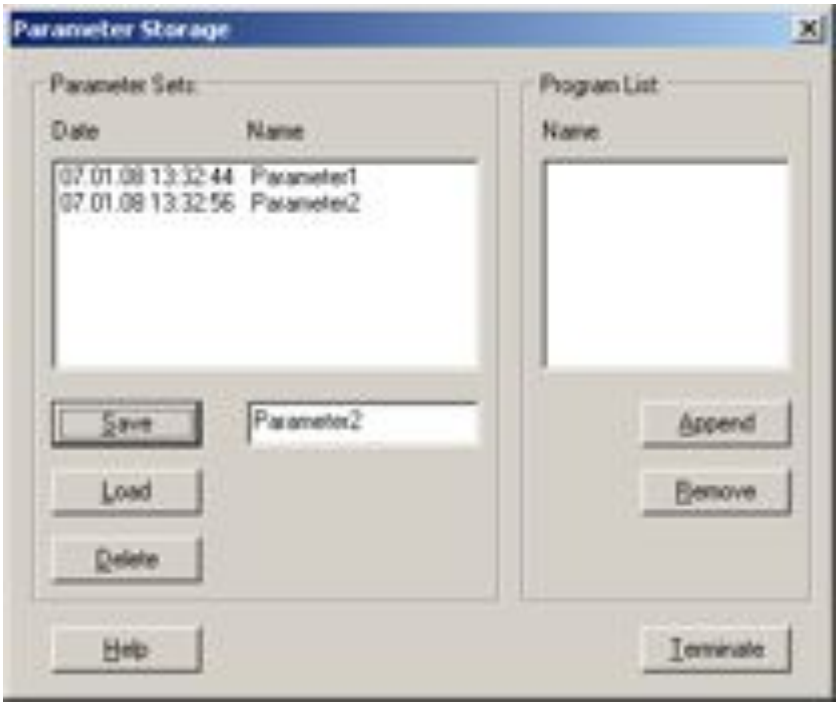


Figure 14 Parameter Storage

Parameter Sets

The parameter memory of the MRR-2 is used for convenient saving and loading of complete parameter settings.

Saving a parameter set:

- Type a name in the field right of the ***Save***-button or select a name of the Parameter Sets list.
- Click the ***Save***-button.

Loading a parameter set:

- Type a name of the Parameter Sets list in the field right of the ***Save***-button or select a name of the Parameter Sets list.
- Click the ***Load***-button.
-

Deleting a parameter set:

- Type a name of the Parameter Sets list in the field right of the ***Save***-button or select a name of the Parameter Sets list.
- Click the ***Delete***-button.

A parameter set consists of

- the device parameters (except calibration constant) and
- the selected output parameters

Program List

Previously defined parameter sets can be added to a program list. All sets, which are included in this list, will be processed successively. This means every time the averaging interval has finished, the next entry will be loaded from the list. After reaching the end of this list, the program starts over with the first entry.

Creating a Program List

- Select a parameter set in the Parameter Sets list
- Click the ***Append*** button. The parameter set is inserted in the empty Program List or added to the end of the non-empty Program List.

As soon as the Program List is not empty, it becomes active.

Removing entries from the Program List

- Select the entry from the Program List
- Click the ***Remove***-button

Note:

1. Parameter sets, which appear in the Program List can neither be changed nor deleted.
2. The same parameter set name may appear at several places in the Pram List.

6.2.6 Status messages and time-axis control

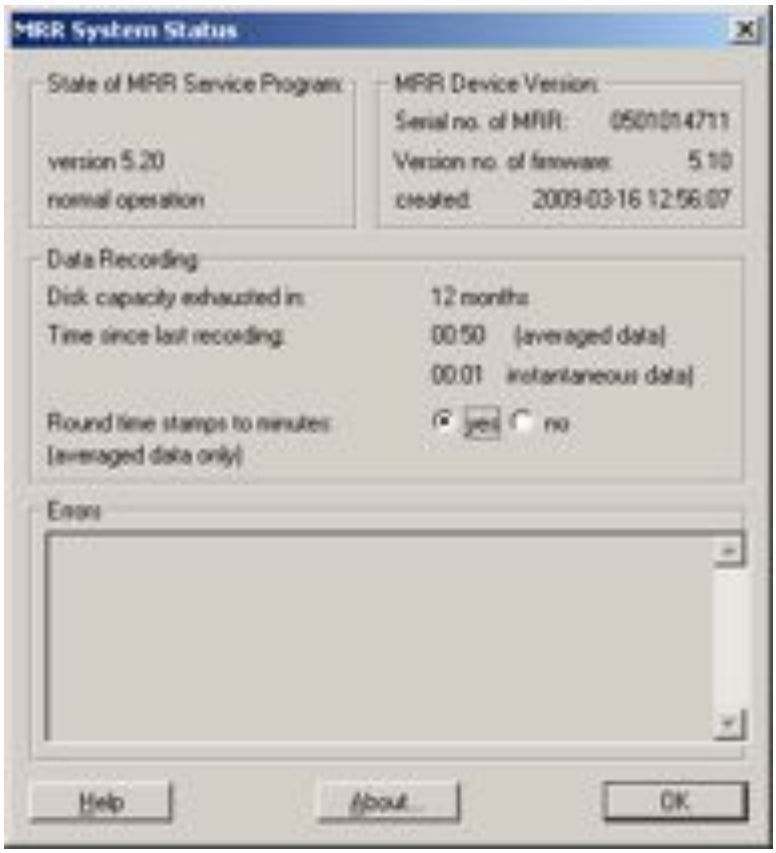


Figure 15 System Status

Sub-Panel: “State of the MRR Service Program”

The version number of the MRR service program is shown.

The operation state is shown:

- *normal operation*
  No problems occurred.
- *erroneous operation*
  One component of the service could not be installed. Either a hardware error or a conflict between programs occurred (Example: Two programs attempt to access the same port.)

Sub-Panel: “MRR Device Version”

The serial number, the firmware version number and the firmware creation date of the connected MRR are shown.

Sub-Panel: “Data Recording”

Disk capacity exhausted in The remaining time for data recording is shown. The calculation is based on the average sizes of the last received measuring protocol and the actual free disk space (Initially **???** appears until the first data set is stored).

Time since last recording The time elapsed, since the last averaged and instantaneous data sets were written to disk, is shown (Initially **???** appears until the first data set is stored).

Round time stamps to minutes Time stamps are rounded to integer values. This can be useful under the following condition: If the "Adjust interval length to real time clock" (see chapter 6.2.2 **Control Commands Menu**) was selected, the time stamps should be integer multiples of 10 seconds, minutes or ten minutes. Nevertheless small deviations from these integers may occur due to variable processing time. If this is disturbing for subsequent data analysis programs, the recorded time stamps can be rounded. The selection *yes* or *no* is activated by pressing the *ok* button.

Sub-Panel “Errors”

This panel shows a list of errors which occurred during the measuring operation. Errors which occurred before the control program was started can be retrieved from the Windows® 2000- or Windows® XP-event log.

About Button

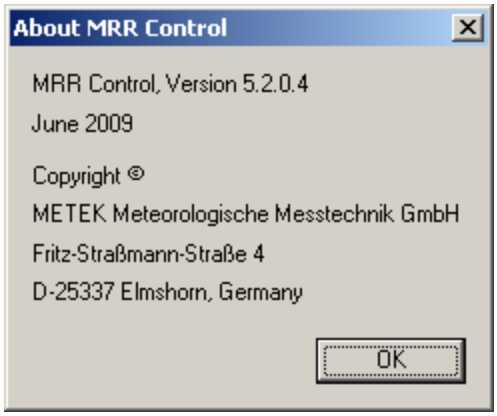


Figure 16 This panel appears after clicking the *About*-button

6.3 Instantaneous and averaged data

6.3.1 Format description

Instantaneous and averaged data are archived in two separate directory structures (see chapter 7.1.2 Data Recording on page 41). Optional recording of so called raw data, which represent the unprocessed measuring data of the MRR-2, is only useful for special purposes.

The data format is human readable ASCII text. Each data set consists of one line. The order of the data lines and the used identifiers are listed below:

Identifier	Meaning	Unit	Remark
MRR	*Header Line*	n.A.	
H	*Height*	m	
TF	*Transfer Function*	dimensionless	
F*nn*	*Spectral Reflectivities*	dB	$10 \cdot \log \eta_{nn}$ with η_{nn} in m^{-1} *nn* from min(*h*) to max(*h*) [3]
D*nn*	*Drop Size*	mm	Center of size class
N*nn*	*Spectral Drop Densities*	$m^{-3}mm^{-1}$	$N(D_{nn})$ [3]
PIA	*Path Integrated Attenuation*	dB	
Z	*Radar Reflectivity*	dBZ	$10 \log\left(\sum_{nn=\min(h)}^{nn=\max(h)} N(D_{nn}) D_{nn}^{6}\right)$ *nn* from min(*h*) to max(*h*)
z	*Attenuated Radar Reflectivity*	dBZ	Z-PIA
RR	*Rain Rate*	mm h^{-1}	
LWC	*Liquid Water Contents*	g m^{-3}	
W	*Fall Velocity*	m s^{-1}	

[1)] *See MRR-Physical Basics for details*.

The measured data are displayed in lines following the header. For each measured variable there is one line starting with a 3-character identifier of the variable. Each line represents a profile of this variable, i.e. a function versus height. Each data entry is 7 characters wide. Height is running from left to right

[3] *See MRR-Physical Basics for details*.

in increments according to the chosen height resolution of the MRR. Invalid or not calculable values are coded as 7 consecutive space characters. Space characters–at the end of a line are omitted in order to save disk space. So lines can have different lengths although representing the same number of height steps.

MRR – Header Line

Entries common to instantaneous and averaged data:

The header line marks the beginning of a data set. It starts with the identifying string ”MRR“, a space character and a date/time stamp.

The date/time stamp consists of 12 digits (format *YYMMDDhhmmss*), a

single space character and the name of the time zone. This name starts with the string „UTC“ and is optionally followed by an offset value (format *±hh* or *±hhss*).

The end of the header line shows a data quality parameter consisting of the identifying string “MDQ”, a single space character and a 3digit number between 0 and 100. It is the percentage of valid spectra collected during the averaging interval. Spectra can be invalid due to saturation of the AD converter – caused either by extreme precipitation or by some interference.

Entries only in averaged data:

Averaging time in seconds (“AVE”), height resolution in meters (“STP”), height of the ground level above sea level in meters (“ASL”), sampling rate (“SMP”) of the RADAR signal in the time domain (unit: Hz), parameters for the automatic noise level adjustment (“NF0” and “NF1” without unit), version number of the MRR Service (“SVS”), version number of the MRR firmware (“DVS”), serial number of the MRR (“DSN”) and the calibration constant (“CC”).

Each of the parameters in the header line starts with a delimiting space character, the 3-character identifier as shown above in the parentheses and a field of 6 characters for the numerical value (except of the serial number, which can consist of up to 10 numeric characters between 0 and 9).

Example (Each entry of the header line is shown in a separate line of the table) :

MRR*090612040200 UTC	The header line dates from June 12th, 2009, 4:02 AM, UTC.
AVE****60	Averaging time is 60 seconds.
STP****35	Height resolution is 35 meters.
ASL***147	The radar is sited 147 meters above sea level.
SMP*125e3	Sampling rate is 125,000 Hz.
NF0*1.000	Noise level 0 set to 1.000 (used only in older versions).
NF1*0.000	Noise level 1 set to 0.000 (used only in older versions).
SVS*5.20	Version number of the MRR Service is 5.20.
DVS*5.10	Version number of the MRR firmware is 5.10.
DSN*020704	Serial number of the MRR is 020704.
CC*2066000	Calibration constant is 2066000.
MDQ*100	Percentage of valid spectra is 100.

H - Height

Argument of the following data profiles corresponding to the settings described in chapter 6.2.3, page 20, and chapter 6.2.4, page 23. The units are meters above the radar system.

TF - Transfer Function

To each height step a value of the Transfer Function is assigned by which raw data are divided.

Fnn with nn from 0 to 63 - FFT Spectra

Each line represents a profile of spectral reflectivity corresponding to the spectral bin *nn*. As **Fnn** is corrected for the receiver noise floor negative values can occur, if the signal to noise ratio is low. These entries cannot be presented in the logarithmic domain and are replaced by space characters.

Dnn with nn from min(h) to max(h) - Drop Sizes

The drop size is described by the diameter of an equivolumic sphere. The spectral bins of drop numbers are of variable width in the size domain (in contrast with spectral bins in the frequency- and velocity-domain). In addition, the

widths of the size bins are slightly height dependent. Therefore the assignment of frequency-bin-index nn to diameter D is listed explicitly for each bin and height. The center of each size class is displayed.

Nnn with nn from min(h) to max(h) - Spectral Drop Densities

With the knowledge of the frequency of the Doppler-shift the calculation of the corresponding drop fall velocity is possible (equation 1.4.3.2 in MRR Physical Basics). Thus each FFT-line stands for a drop size interval. Chapter 2 in the Physical Basics shows how to derive from the received spectral power the number of drops for this drop size class, and finally – by divison through the variable class width – the spectral drop densities.
Only a sub-set of all 64 spectral bins is considered for the calculation. The lower (min(h)) and upper limit (max(h)) depends on the height as described in MRR Physical Basics (Fig. 7).
In case of negative values of Fnn negative drop number densities are calculated. Although they have no physical meaning they are retained in order to avoid statistical biases.

PIA - Path Integrated Attenuation [1)]

The two-way Path integrated attenuation by rain drops is calculated as described in chapter 3.2 MRR-Physical Basis and is used for correction of Nnn, Z, RR and LWC.

z - Attenuated Radar Reflectivity[2)]

z is the radar reflectivity factor (see chapter 3.1 MRR-Physical Basics) without attenuation correction

Z - Radar Reflectivity[2)]

Z is the radar reflectivity factor (see chapter 3.1 MRR-Physical Basics)

RR - Rain Rate[2)]

RR is the rain rate (see chapter 3.3 MRR-Physical Basics)

LWC - Liquid Water Content[2)]

LWC is the liquid water content (see equation 3.2.1 MRR-Physical Basics)

[2)] *In case of low signal to noise ratio negative values can occur. Although they have no physical meaning they are retained in order to avoid statistical biases*.

W - Fall Velocity

W is the characteristic falling velocity.
(First Moment of the Doppler spectrum, see chapter 3.4 MRR-Physical Basics).

The width of velocity-bins can be derived from the maximum number of height steps, the sampling rate (as shown in the header line) and the wave length of the RADAR signal. 32 height steps and 64 lines per step are calculated. For a sampling frequency of 125 kHz and a transmit frequency of 24.15 GHz, the resolution of the fall velocity can be calculated as:

$$\frac{125\,\mathrm{kHz}}{2}\,\frac{1}{32\cdot 64}\,\frac{299700\ \mathrm{km/s}}{2\cdot 24\,\mathrm{GHz}} = 0.1905\ \mathrm{m/s}$$

6.3.2 Example

Instantaneous and **averaged data** files have the same structure except of the header lines. The part of the header line, which is underlined in the example below, is only present in <u>averaged data</u>:

```
MRR 090612040200 UTC AVE     60 STP     35 ASL      0 SMP 125e3 NF0 1.000 NF1 0.000 SVS 5.20 DVS 5.10 DSN 020704 CC 2066000 MDQ 100
H       35     70    105    140    175    210    245    280    315    350    385    420    455    490    525    560    595    630    665    700    735    770    805    840    875    910    945    980   1015   1050   1085
TF  0.0115 0.0420 0.0999 0.1756 0.2542 0.3340 0.4255 0.5324 0.6030 0.6757 0.7565 0.7942 0.8366 0.8778 0.8914 1.0000 0.9683 0.9243 0.8838 0.8904 0.9040 0.8759 0.8538 0.8433 0.8346 0.7807 0.7749 0.7524 0.6890 0.6406 0.4225
F00 -65.29 -74.53 -82.05 -87.75 -90.83 -91.33 -91.50 -94.20              -106.26        -90.26 -89.09 -89.00 -91.35 -92.31              -97.45 -98.65       -91.66 -89.67 -82.65 -82.43 -83.39 -82.92 -82.32 -87.28 -83.34
F01 -66.94 -76.22 -84.02 -89.60 -92.92 -90.74 -90.22 -91.96 -98.48 -93.34 -92.11 -94.45 -86.71 -86.55 -86.06 -87.13 -86.23 -86.12 -87.00 -87.60 -89.90 -89.54 -83.82 -83.08 -80.77 -80.17 -79.91 -80.16 -80.55 -85.48 -84.48
F02 -72.75 -81.78 -88.82 -93.49 -95.53 -90.61 -89.73 -90.07 -91.23 -89.44 -88.96 -88.11 -84.14 -84.20 -83.97 -84.47 -83.51 -82.95 -83.39 -83.78 -85.48 -82.83 -80.38 -80.66 -79.75 -79.03 -78.00 -77.93 -79.20 -84.64 -84.43
F03 -82.02 -88.54 -91.72 -95.03 -94.67 -90.35 -89.07 -89.06 -89.11 -88.73 -87.65 -86.96 -83.49 -83.15 -83.76 -84.45 -83.31 -82.42 -82.31 -81.95 -82.49 -80.82 -79.11 -79.94 -79.96 -78.79 -77.68 -78.09 -79.97 -85.73 -84.42
F04 -88.10 -89.28 -91.25 -93.59 -93.01 -89.24 -88.55 -88.52 -87.96 -87.75 -86.36 -86.62 -83.91 -83.20 -84.08 -84.65 -83.34 -82.21 -81.64 -81.08 -80.83 -80.01 -78.92 -79.43 -79.85 -78.92 -78.32 -79.59 -81.30 -87.44 -89.43
F05 -87.30 -88.16 -90.08 -91.37 -90.76 -87.91 -87.93 -88.12 -87.23 -86.03 -85.55 -85.93 -83.96 -83.56 -83.46 -83.48 -83.08 -81.79 -80.80 -80.48 -80.31 -80.04 -79.39 -79.69 -79.70 -79.05 -79.05 -80.49 -81.83 -92.29
F06 -86.28 -87.67 -89.08 -89.78 -89.56 -87.00 -86.86 -87.26 -86.60 -84.90 -84.87 -85.42 -83.82 -83.16 -81.80 -81.73 -82.05 -81.64 -80.52 -80.39 -80.10 -80.05 -79.87 -79.89 -79.57 -79.54 -79.82 -80.68 -81.55 -91.37
F07 -85.61 -87.55 -87.62 -87.87 -88.59 -86.53 -85.65 -85.65 -85.22 -84.25 -84.12 -84.48 -83.35 -82.33 -80.94 -80.79 -81.24 -81.80 -81.09 -80.80 -80.21 -79.90 -80.26 -80.11 -80.14 -80.32 -80.92 -81.36 -80.73 -86.27 -90.26
F08 -85.09 -86.74 -85.56 -85.78 -87.12 -85.88 -84.82 -84.31 -83.53 -83.16 -83.51 -83.70 -82.61 -81.83 -80.95 -80.77 -81.04 -81.61 -81.21 -81.00 -80.65 -79.74 -80.34 -80.91 -81.45 -81.12 -81.86 -83.43 -80.90 -83.80 -86.63
F09 -83.82 -85.29 -84.11 -84.49 -85.50 -84.67 -83.86 -83.45 -82.85 -82.34 -82.85 -83.29 -82.07 -81.43 -80.82 -80.91 -81.09 -81.14 -80.36 -80.60 -80.82 -79.78 -79.96 -80.97 -81.79 -81.54 -81.74 -85.51 -83.05 -86.41 -87.24
F10 -81.72 -83.85 -83.09 -83.53 -84.12 -83.04 -82.34 -82.48 -82.97 -81.99 -81.72 -82.26 -81.23 -80.89 -79.95 -80.47 -80.97 -80.60 -79.69 -80.18 -80.62 -80.34 -80.30 -80.81 -81.04 -81.24 -81.55 -86.03 -87.40        -86.95
F11 -80.23 -82.49 -81.94 -82.30 -82.87 -81.75 -81.02 -81.68 -82.53 -81.59 -80.59 -80.79 -80.37 -80.35 -79.23 -79.76 -80.65 -80.37 -79.30 -79.57 -80.19 -80.93 -79.99 -80.16 -80.66 -80.97 -82.35 -85.89 -84.87-101.37 -83.71
F12 -79.40 -81.17 -80.57 -81.10 -81.90 -80.83 -80.14 -80.97 -81.54 -80.92 -79.88 -79.77 -79.65 -79.78 -79.11 -79.41 -79.88 -79.90 -78.92 -79.10 -79.78 -80.83 -79.01 -78.79 -80.08 -80.50 -82.59 -84.83 -81.59 -86.14 -78.92
F13 -78.57 -79.85 -79.34 -80.17 -80.79 -79.95 -79.19 -79.97 -80.56 -79.90 -79.10 -79.05 -78.80 -78.77 -78.83 -79.30 -79.17 -79.27 -78.68 -79.00 -79.44 -80.03 -78.76 -78.40 -79.50 -80.26 -81.78 -83.31 -80.78 -81.78 -74.26
F14 -77.86 -78.66 -78.36 -79.29 -79.47 -79.02 -78.43 -79.04 -79.33 -78.74 -78.19 -78.20 -77.69 -77.59 -78.06 -78.72 -78.69 -78.80 -78.75 -79.12 -79.01 -79.18 -78.82 -78.63 -79.50 -80.22 -80.71 -81.93 -79.66 -76.73 -69.46
F15 -77.06 -77.59 -77.41 -78.22 -78.28 -77.92 -77.74 -78.16 -78.00 -77.48 -77.22 -77.24 -76.68 -76.54 -76.80 -77.43 -77.98 -78.33 -78.52 -78.87 -78.50 -78.60 -78.48 -78.32 -79.13 -79.11 -78.99 -80.89 -77.10 -71.53 -65.20
F16 -75.62 -76.37 -76.39 -77.05 -77.13 -76.54 -76.42 -77.07 -76.64 -76.07 -76.25 -76.30 -75.84 -75.36 -75.42 -76.32 -77.01 -77.52 -77.90 -78.21 -77.66 -77.64 -77.62 -77.52 -77.96 -77.19 -77.11 -78.89 -73.66 -66.92 -61.51
F17 -74.28 -75.27 -75.46 -76.15 -76.17 -75.52 -75.10 -76.04 -75.61 -74.93 -75.36 -75.26 -74.86 -74.28 -74.56 -75.66 -76.04 -76.46 -76.79 -77.19 -76.41 -76.18 -76.40 -76.50 -76.91 -76.00 -75.74 -76.16 -70.42 -63.54 -58.70
F18 -73.30 -74.28 -74.44 -75.24 -75.17 -74.85 -74.28 -75.21 -74.97 -74.16 -74.31 -74.12 -73.73 -73.29 -73.78 -74.76 -75.05 -75.41 -75.66 -76.02 -75.32 -74.98 -75.23 -75.52 -75.95 -75.31 -74.85 -73.83 -67.66 -61.18 -56.98
F19 -72.19 -73.25 -73.11 -73.83 -73.90 -73.99 -73.53 -74.48 -74.45 -73.55 -73.39 -73.38 -73.07 -72.71 -73.02 -73.69 -74.16 -74.47 -74.70 -74.94 -74.59 -74.35 -74.37 -74.39 -74.76 -74.30 -73.62 -71.82 -65.18 -59.40 -56.03
F20 -71.06 -71.94 -71.65 -72.48 -72.64 -72.75 -72.76 -73.91 -73.58 -72.59 -72.57 -72.82 -72.54 -72.33 -72.47 -72.85 -73.39 -73.47 -73.71 -73.92 -73.92 -73.53 -73.45 -73.19 -73.43 -73.15 -72.01 -69.70 -62.92 -57.99 -55.55
F21 -70.02 -70.51 -70.34 -71.50 -71.71 -71.55 -71.83 -73.00 -72.18 -71.17 -71.48 -71.86 -71.54 -71.43 -71.38 -71.83 -72.46 -72.42 -72.58 -73.05 -73.21 -72.67 -72.50 -72.30 -72.43 -71.97 -70.28 -67.47 -61.00 -56.68 -55.21
F22 -68.79 -69.29 -69.18 -70.49 -70.98 -70.52 -70.58 -71.37 -70.74 -69.96 -70.42 -70.53 -70.18 -70.11 -70.08 -70.71 -71.41 -71.50 -71.35 -71.96 -72.40 -72.07 -71.61 -71.21 -71.26 -70.44 -68.25 -65.05 -59.54 -55.98 -55.17
F23 -67.82 -68.28 -67.92 -69.21 -70.09 -69.44 -69.18 -69.79 -69.44 -68.87 -69.17 -69.15 -69.06 -68.89 -69.10 -69.83 -70.32 -70.70 -70.43 -71.05 -71.55 -71.38 -70.36 -69.87 -69.98 -69.02 -66.26 -62.66 -58.11 -55.69 -55.47
F24 -67.15 -67.36 -66.44 -67.78 -68.80 -68.20 -67.68 -68.51 -68.14 -67.47 -67.70 -68.06 -68.37 -67.87 -68.08 -69.04 -69.32 -69.80 -69.84 -70.40 -70.56 -70.35 -69.20 -68.77 -68.81 -67.44 -64.25 -60.49 -56.56 -55.26 -55.78
F25 -66.05 -66.05 -65.20 -66.62 -67.44 -66.85 -66.12 -67.10 -66.86 -66.14 -66.49 -67.01 -67.58 -66.93 -66.97 -68.14 -68.35 -68.74 -69.28 -69.68 -69.55 -69.24 -68.32 -67.77 -67.46 -65.57 -62.26 -58.67 -55.36 -54.98 -56.32
F26 -64.87 -64.49 -64.33 -66.00 -66.29 -65.55 -64.75 -65.61 -65.58 -65.09 -65.48 -65.65 -66.37 -66.03 -65.95 -67.03 -67.47 -67.83 -68.44 -68.75 -68.79 -68.39 -67.40 -66.55 -65.95 -63.88 -60.49 -57.31 -54.80 -55.01 -56.92
F27 -63.97 -63.27 -63.33 -64.91 -64.92 -64.37 -63.66 -64.41 -64.32 -64.00 -64.29 -64.24 -64.95 -64.87 -64.77 -65.51 -66.43 -67.06 -67.47 -67.73 -68.02 -67.71 -66.55 -65.37 -64.70 -62.52 -59.00 -56.22 -54.55 -55.34 -57.81
F28 -62.71 -62.26 -62.06 -63.11 -63.14 -63.15 -62.71 -63.46 -63.21 -62.75 -62.88 -62.91 -63.54 -63.48 -63.52 -64.01 -65.01 -65.98 -66.46 -66.83 -67.19 -67.08 -65.77 -64.46 -63.50 -61.06 -57.75 -55.43 -54.59 -55.99 -59.16
F29 -61.64 -61.26 -60.96 -61.81 -61.73 -61.97 -61.99 -62.76 -62.47 -61.77 -61.73 -61.70 -62.10 -62.06 -62.24 -62.73 -63.41 -64.36 -65.13 -65.81 -66.21 -66.35 -64.87 -63.37 -61.92 -59.25 -56.59 -54.95 -54.97 -57.05 -60.88
F30 -60.93 -60.35 -60.19 -61.05 -60.86 -60.96 -61.18 -61.97 -61.69 -61.04 -60.94 -60.69 -60.86 -60.90 -61.05 -61.64 -61.97 -62.66 -63.51 -64.45 -64.83 -65.13 -63.87 -62.14 -60.43 -57.72 -55.79 -54.73 -55.43 -58.37 -62.82
F31 -60.03 -59.37 -59.43 -60.18 -60.14 -60.01 -60.14 -60.97 -60.75 -60.35 -60.31 -60.02 -59.96 -59.90 -60.10 -60.78 -60.95 -61.23 -61.88 -62.84 -63.17 -63.41 -62.83 -60.99 -59.02 -56.61 -55.45 -54.90 -56.19 -59.79 -64.76
F32 -59.11 -58.53 -58.62 -59.27 -59.40 -59.14 -59.28 -59.96 -59.81 -59.68 -59.59 -59.39 -59.37 -59.20 -59.25 -60.04 -60.05 -60.02 -60.45 -61.27 -61.84 -62.14 -61.81 -59.77 -57.60 -55.84 -55.46 -55.47 -57.31 -61.23 -66.56
F33 -58.30 -57.67 -57.79 -58.49 -58.75 -58.35 -58.59 -59.22 -59.21 -59.17 -58.87 -58.61 -58.78 -58.71 -58.53 -59.24 -58.93 -58.97 -59.41 -59.93 -60.69 -61.07 -60.77 -58.72 -56.67 -55.39 -55.52 -56.25 -58.70 -63.05 -68.60
F34 -57.80 -56.89 -57.20 -57.92 -58.22 -57.85 -58.24 -58.94 -59.08 -58.76 -58.23 -57.84 -57.96 -58.08 -58.04 -58.52 -57.94 -58.13 -58.72 -58.96 -59.58 -59.66 -59.47 -57.95 -56.27 -55.16 -55.58 -57.07 -60.24 -65.50 -71.44
F35 -57.42 -56.24 -56.86 -57.55 -57.72 -57.51 -58.11 -58.85 -58.89 -58.22 -57.86 -57.50 -57.42 -57.61 -57.79 -58.16 -57.49 -57.70 -58.21 -58.35 -58.95 -58.50 -58.10 -57.14 -56.13 -55.45 -56.09 -58.00 -61.53 -67.89 -74.75
F36 -56.94 -55.77 -56.65 -57.23 -57.32 -57.16 -57.70 -58.51 -58.44 -57.78 -57.74 -57.62 -57.39 -57.47 -57.60 -58.10 -57.66 -57.67 -57.74 -57.92 -58.48 -57.74 -57.13 -56.53 -56.19 -56.33 -57.35 -59.65 -63.32 -70.14 -77.61
F37 -56.69 -55.63 -56.60 -57.12 -57.06 -56.75 -57.22 -58.05 -58.10 -57.75 -57.78 -57.68 -57.46 -57.58 -57.64 -58.24 -57.98 -57.69 -57.39 -57.61 -57.87 -57.20 -56.69 -56.39 -56.33 -57.10 -59.08 -61.94 -65.92 -73.07 -79.88
F38 -56.67 -55.72 -56.69 -57.05 -56.76 -56.40 -57.05 -58.02 -58.14 -57.81 -57.68 -57.48 -57.26 -57.65 -57.86 -58.40 -58.14 -57.68 -57.27 -57.43 -57.40 -56.86 -56.47 -56.32 -56.65 -57.86 -60.77 -64.24 -68.62 -76.39 -79.07
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D07 0.3562 0.3559 0.3555 0.3552 0.3548 0.3545 0.3542 0.3538 0.3535 0.3531 0.3528 0.3524 0.3521 0.3517 0.3514 0.3510 0.3507 0.3503 0.3500 0.3497 0.3493 0.3490 0.3486 0.3483 0.3479 0.3476 0.3472 0.3469 0.3465 0.3462 0.3458
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D14 0.6471 0.6463 0.6455 0.6446 0.6438 0.6430 0.6422 0.6414 0.6405 0.6397 0.6389 0.6381 0.6372 0.6364 0.6356 0.6348 0.6340 0.6331 0.6323 0.6315 0.6307 0.6299 0.6290 0.6282 0.6274 0.6266 0.6258 0.6249 0.6241 0.6233 0.6225
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D39 2.5515 2.5443 2.5372 2.5301 2.5230 2.5160 2.5089 2.5019 2.4950 2.4880 2.4811 2.4742 2.4673 2.4605 2.4537 2.4469 2.4401 2.4333 2.4266 2.4199 2.4132 2.4066 2.4000 2.3934 2.3868 2.3802 2.3737 2.3672 2.3607 2.3542 2.3478
D40 2.7002 2.6922 2.6842 2.6763 2.6684 2.6605 2.6526 2.6448 2.6370 2.6293 2.6215 2.6138 2.6062 2.5985 2.5909 2.5834 2.5758 2.5683 2.5609 2.5534 2.5460 2.5386 2.5312 2.5239 2.5166 2.5094 2.5021 2.4949 2.4877 2.4806 2.4735
D41 2.8636 2.8546 2.8455 2.8366 2.8276 2.8187 2.8099 2.8011 2.7923 2.7836 2.7749 2.7662 2.7576 2.7491 2.7406 2.7321 2.7236 2.7152 2.7069 2.6985 2.6902 2.6820 2.6738 2.6656 2.6575 2.6494 2.6413 2.6333 2.6253 2.6173 2.6094
D42 3.0448 3.0344 3.0241 3.0139 3.0037 2.9936 2.9835 2.9735 2.9636 2.9537 2.9438 2.9340 2.9243 2.9146 2.9049 2.8954 2.8858 2.8763 2.8669 2.8575 2.8482 2.8389 2.8296 2.8204 2.8113 2.8022 2.7931 2.7841 2.7752 2.7663 2.7574
D43 3.2480 3.2361 3.2242 3.2124 3.2006 3.1890 3.1774 3.1659 3.1545 3.1431 3.1318 3.1206 3.1094 3.0983 3.0873 3.0764 3.0655 3.0547 3.0439 3.0333 3.0226 3.0121 3.0016 2.9911 2.9808 2.9705 2.9602 2.9500 2.9399 2.9298 2.9198
D44 3.4796 3.4655 3.4516 3.4377 3.4240 3.4104 3.3968 3.3834 3.3701 3.3569 3.3437 3.3307 3.3178 3.3049 3.2922 3.2795 3.2669 3.2544 3.2421 3.2297 3.2175 3.2054 3.1933 3.1814 3.1695 3.1577 3.1459 3.1343 3.1227 3.1112 3.0998
D45 3.7485 3.7317 3.7149 3.6984 3.6820 3.6657 3.6496 3.6336 3.6178 3.6021 3.5866 3.5712 3.5559 3.5408 3.5257 3.5109 3.4961 3.4815 3.4669 3.4525 3.4383 3.4241 3.4101 3.3961 3.3823 3.3686 3.3550 3.3415 3.3281 3.3148 3.3016
D46 4.0694 4.0485 4.0279 4.0075 3.9873 3.9674 3.9477 3.9282 3.9089 3.8898 3.8710 3.8523 3.8338 3.8156 3.7975 3.7796 3.7619 3.7443 3.7270 3.7098 3.6928 3.6759 3.6592 3.6427 3.6263 3.6101 3.5940 3.5781 3.5623 3.5467 3.5312
D47 4.4672 4.4402 4.4135 4.3873 4.3615 4.3360 4.3109 4.2862 4.2618 4.2378 4.2140 4.1906 4.1676 4.1448 4.1223 4.1001 4.0782 4.0566 4.0352 4.0141 3.9933 3.9727 3.9523 3.9322 3.9123 3.8927 3.8732 3.8540 3.8350 3.8162 3.7977
D48 4.9907 4.9530 4.9161 4.8800 4.8447 4.8100 4.7761 4.7427 4.7101 4.6780 4.6466 4.6156 4.5853 4.5555 4.5262 4.4973 4.4690 4.4411 4.4137 4.3867 4.3601 4.3339 4.3082 4.2828 4.2578 4.2331 4.2088 4.1848 4.1612 4.1379 4.1149
D49 5.7582 5.6977 5.6392 5.5826 5.5279 5.4749 5.4235 5.3736 5.3252 5.2781 5.2322 5.1876 5.1441 5.1017 5.0603 5.0199 4.9804 4.9419 4.9042 4.8673 4.8312 4.7958 4.7612 4.7273 4.6940 4.6614 4.6294 4.5980 4.5672 4.5369 4.5071
D50                                                                                                                                                 5.7853 5.7220 5.6610 5.6022 5.5453 5.4903 5.4370 5.3854 5.3353 5.2866 5.2393 5.1933 5.1486 5.1050 5.0624 5.0210
D51                                                                                                                                                
```

N34	15543	19429	18430	15880	15100	16759	15610	13544	13375	14668	16884	18871	18722	18590	19172	17529	20454	20027	17849	17282	15318	15391	16430	23729	35545	46676	43087	31116	15240	4622.4	1196.3
N35	11074	14746	13021	11318	11080	11857	10535	9071.8	9153.5	10891	12100	13423	13959	13631	13374	12554	14989	14600	13282	13155	11733	13308	14872	18890	24295	28910	25386	16667	7517.4	1769.8	372.01
N36	8063.7	10718	8927.8	7966.0	7954.2	8413.8	7584.7	6429.2	6668.3	7912.6	8156.4	8572.4	9241.6	9262.2	9187.0	8380.0	9491.1	9687.6	9774.1	9585.0	8641.0	10461	12281	14376	15828	15629	12579	7542.3	3299.7	699.22	127.95
N37	5579.9	7232.0	5896.5	5342.4	5529.4	6050.6	5548.5	4679.9	4724.6	5237.0	5312.6	5556.1	5978.6	5945.9	6001.2	5351.7	5813.2	6361.6	6982.7	6806.1	6566.6	7816.2	8969.7	9791.1	10116	8644.9	5594.9	2947.6	1201.5	236.46	50.288
N38	3660.6	4631.9	3782.0	3554.0	3882.1	4301.2	3788.2	3094.7	3073.3	3388.5	3572.4	3826.3	4115.9	3848.7	3753.9	3401.1	3693.0	4212.3	4742.4	4694.6	4822.6	5578.4	6223.4	6570.3	6224.6	4805.3	2510.5	1149.9	428.02	73.016	40.260
N39	2451.6	3052.0	2462.6	2454.8	2701.9	2879.9	2516.2	1986.3	1970.7	2224.8	2389.8	2510.6	2621.3	2340.3	2308.5	2145.4	2363.8	2776.2	3040.2	2991.0	3206.6	3590.5	4066.8	4184.1	3400.7	2300.2	1089.4	447.38	153.45	23.465	45.138
N40	1619.3	2074.6	1583.4	1582.6	1763.5	1834.0	1574.2	1260.2	1294.3	1402.1	1458.3	1450.0	1468.7	1288.6	1363.3	1331.0	1495.8	1722.1	1838.6	1847.8	2074.7	2231.3	2468.2	2294.7	1631.5	949.15	424.41	166.03	51.607	6.7670	45.100
N41	982.38	1326.3	973.26	959.24	1050.9	1068.5	858.33	744.14	829.82	857.60	842.94	812.12	831.79	723.97	797.48	805.01	917.07	1012.8	1109.3	1210.2	1333.5	1407.9	1414.7	1116.5	712.05	366.94	154.27	62.599	17.781	2.8902	43.531
N42	559.59	801.97	590.94	560.59	570.14	570.07	441.00	428.44	513.44	509.34	483.11	472.63	466.78	408.14	449.80	443.00	503.02	542.48	648.21	783.12	818.78	829.53	748.08	508.35	280.57	132.16	51.527	21.089	5.7216	1.2082	41.131
N43	311.72	452.26	341.63	311.89	298.49	296.60	243.05	266.12	315.43	285.84	267.08	259.91	236.88	207.13	222.80	211.03	240.93	268.09	351.68	453.51	472.69	455.83	358.53	206.85	103.39	45.136	16.576	5.5499	1.1879	0.9027	36.637
N44	169.68	239.35	178.44	164.85	152.13	148.30	137.29	172.38	192.97	159.46	138.54	126.42	111.82	93.173	92.717	91.467	109.10	127.54	181.10	233.85	246.11	239.27	169.73	76.829	36.747	15.236	5.1847	1.0163	0.1858	1.2911	32.235
N45	81.786	121.41	84.666	81.660	79.681	78.907	77.345	103.17	113.45	92.542	68.828	57.519	50.597	37.522	33.149	36.609	47.387	54.895	82.849	112.99	119.13	115.14	76.344	28.340	11.652	4.4790	1.2523	-0.1501	0.1087	1.4566	27.688
N46	34.401	57.447	38.938	39.926	41.450	43.409	45.297	54.983	60.493	52.144	33.413	25.366	20.018	12.808	11.334	13.548	17.845	20.532	31.125	48.032	53.157	48.112	29.404	9.4621	3.2046	1.0200	0.1508	-0.1471	0.2992	1.2458	21.402
N47	14.599	25.105	17.415	18.311	18.017	21.264	26.064	29.209	30.549	26.836	16.089	11.018	7.6411	4.1295	3.6462	4.5463	5.7951	6.7475	9.5651	16.130	19.956	17.000	9.3864	2.6096	0.7768	0.2122	0.0214	-0.0118	0.3312	0.8860	14.571
N48	6.0655	10.083	6.7792	6.7683	6.5345	9.1416	12.917	15.288	15.165	12.710	7.4520	4.6330	3.0609	1.3756	0.9208	1.3419	1.6967	1.8734	2.5597	4.3964	6.1000	4.8768	2.2767	0.5247	0.0722	-0.0227	9.6e-4	-0.0267	0.2702	0.6419	8.2911
N49	2.5061	3.6136	2.2706	1.9711	2.0213	3.5677	5.5743	7.8399	7.7926	5.9892	3.3414	1.7142	0.9998	0.3713	0.1577	0.3096	0.3850	0.3988	0.6132	1.0605	1.5677	1.1634	0.4705	0.1001	-0.0409	-0.0489	0.0142	0.0276	0.2706	0.4230	4.0321
N50																0.0510	0.0522	0.0533	0.1262	0.2087	0.3256	0.2438	0.1037	0.0316	0.0116	0.0055	0.0252	0.0680	0.2527	0.3298	1.8604
N51																															0.7945
PIA	0.000	0.028	0.054	0.076	0.097	0.120	0.143	0.162	0.182	0.204	0.226	0.248	0.270	0.292	0.315	0.334	0.354	0.374	0.395	0.414	0.433	0.453	0.475	0.500	0.528	0.565	0.610	0.667	0.743	0.833	0.939
z	32.52	33.54	32.65	32.07	31.98	32.17	31.91	31.51	31.60	31.57	31.22	31.08	30.90	30.59	30.51	30.04	30.24	30.28	30.36	30.40	30.31	30.37	30.39	30.55	30.90	31.57	32.08	32.73	33.37	33.36	33.33
Z	32.52	33.56	32.69	32.14	32.07	32.29	32.05	31.67	31.77	31.77	31.43	31.32	31.16	30.87	30.82	30.37	30.59	30.65	30.75	30.82	30.75	30.83	30.87	31.06	31.44	32.15	32.69	33.40	34.10	34.18	34.25
RR	2.93	3.25	3.09	2.58	2.52	2.71	2.69	2.31	2.41	2.68	2.69	2.72	2.74	2.79	2.81	2.49	2.47	2.42	2.41	2.30	2.24	2.35	2.62	3.00	3.46	4.53	5.96	8.08	12.16	16.29	20.79
LWC	0.17	0.18	0.17	0.14	0.14	0.15	0.16	0.14	0.14	0.16	0.17	0.17	0.18	0.19	0.19	0.17	0.17	0.18	0.19	0.18	0.18	0.20	0.22	0.23	0.25	0.31	0.40	0.50	0.76	1.07	1.49
W	6.57	6.73	6.57	6.66	6.68	6.81	6.84	6.95	6.90	6.72	6.57	6.51	6.53	6.42	6.45	6.48	6.58	6.68	6.83	6.99	7.09	7.10	7.00	6.77	6.50	6.20	5.88	5.53	5.11	4.61	4.16

6.4 Raw data

6.4.1 Format Description

Each data block in a **raw data** file begins with a header line which contains the date, the time and the time zone of the following data block. This line is preceded by the letter T and a colon (T means time). The format of the date/time stamp is YYMMDDhhmmss, which means year, month, day, hour, minute and second with 2 digits each. Date, time and time zone are separated by a space character. The header line is supplemented with the version number of the MRR firmware (following the identifier DVS), the serial number (of the MRR (following the identifier DSN), the calibration constant of the MRR (following the identifier CC) and the percentage of valid spectra (following the identifier MDQ).

The next data lines contains the measuring heights. It begins with the capital letter M, a colon, the small letter h, two space characters, and an equals sign (M means measured value, h means height). The following numbers (9 digits decimal each) represent the measuring heights in meters.

The height line is followed by the line of the transfer function. It starts with the capital character M, a colon, the capital letters T and F and one space character. The rest of that line represents the values of the transfer function for each height step (9 digits decimal each).

The line of the transfer function is followed by 64 data lines. Each one starts with the capital character M, a colon, the small letter f, and a 2-digit number of the spectra line (0 to 63). The rest of these lines represent the received spectral signal power in engineering units for each height step (9 digits decimal each).

The raw spectra include the receiver noise floor.

6.4.2 Example

```
T:090612024311 UTC DVS 5.10 DSN 020704 CC 2066000 MDQ 100
H:h  =    0   35   70  105  140  175  210  245  280  315  350  385  420  455  490  525  560  595  630  665  700  735  770  805  840  875  910  945  980 1015 1050 1085
M:TF = 0.003292 0.011523 0.041975 0.099863 0.175583 0.254184 0.334019 0.425514 0.532373 0.603018 0.675720 0.756516 0.794239 0.836626 0.877778 0.891358 1.000000 0.968313 0.924280 0.883813 0.890398 0.903978 0.875857 0.853772 0.843347 0.834568 0.780658 0.774897 0.752401 0.689026 0.640604 0.422497
M:f00=  4798  2205   166    46    22    20    20    20    19    18    18    23    24    24    19    15    15    18    16    15    18    15    12    12    10    10    11    10     7     6     6     4
M:f01=  2780  1272   107    33    19    20    25    23    22    20    22    28    29    27    22    18    18    20    18    21    25    21    15    14    12    12    12    12    11     8     7     5
M:f02=   541   246    33    20    22    22    27    27    26    25    26    32    34    32    28    23    25    25    24    28    30    25    17    17    16    13    13    14    15    10     8     6
M:f03=    39    22    17    20    25    24    27    28    28    26    26    31    35    33    28    24    29    28    25    27    28    25    19    21    19    14    14    14    13    11     8     6
M:f04=     4     9    18    22    25    24    27    30    29    26    24    26    30    27    24    27    34    30    25    24    25    24    20    22    20    14    15    14    12    12     9     6
M:f05=     3     9    19    26    27    24    26    30    29    31    26    21    25    22    20    30    36    31    26    23    23    22    18    19    17    12    13    13    11    12    11     7
M:f06=     3     9    20    32    32    24    24    28    30    33    27    22    27    24    21    30    35    30    27    23    23    19    18    16    14    11    11    11    12    13    12     7
M:f07=     3     9    21    38    38    27    24    25    27    30    27    25    30    27    24    31    33    31    29    26    24    20    20    16    13    11    13    13    11    12    12     7
M:f08=     3    10    23    49    48    32    26    24    22    29    30    27    29    30    31    34    32    31    32    28    25    22    24    16    13    13    16    15    10    10    11     6
M:f09=     4    11    28    61    54    36    29    25    24    30    33    28    29    35    38    35    36    33    32    27    24    21    23    15    15    17    17    15    10     9    10     6
M:f10=     5    13    34    70    56    38    34    30    32    32    34    33    33    43    46    38    41    37    30    25    24    19    19    17    20    20    17    14    12    12     9     5
M:f11=     4    16    44    85    60    39    38    35    37    34    35    39    36    47    54    48    47    39    30    24    22    19    20    21    26    20    16    14    13    14     8     4
M:f12=     5    18    55   107    71    48    47    42    42    41    40    43    37    46    57    54    55    45    30    24    21    20    20    23    29    21    16    15    14    13     7     4
M:f13=     7    19    65   137    93    75    60    46    47    52    51    47    38    47    56    52    61    52    34    23    23    24    21    29    33    28    21    18    17    13     6     5
M:f14=     9    23    84   198   141   127    88    49    53    61    56    48    39    53    62    59    68    60    42    29    28    29    26    37    40    38    31    24    21    15     9     6
M:f15=    12    34   139   329   220   182   124    60    62    75    64    54    45    65    80    78    80    71    52    39    34    35    41    47    49    41    36    29    24    17    12     7
M:f16=    15    52   236   522   336   215   136    69    74    88    74    65    59    78    92    93    91    84    63    49    42    46    65    64    57    42    37    31    28    19    12     8
M:f17=    24    75   325   698   485   275   150    81    85    90    85    79    83    99   100   101   101   102    83    58    54    61    78    72    61    48    41    33    31    22    12     7
M:f18=    48   120   374   710   569   364   199   116   115   112   105    94   106   132   127   108   112   125   106    71    68    70    77    73    61    48    42    32    30    23    12     7
M:f19=    98   215   526   747   595   418   242   166   178   168   133   115   126   152   157   123   132   157   136   101    88    78    71    73    63    44    38    29    27    25    15     9
M:f20=   177   377   803   915   652   452   268   217   240   236   188   149   155   169   192   159   168   182   170   139   115   101    76    65    63    43    36    29    27    29    19    11
M:f21=   290   582  1054  1084   739   488   303   257   276   295   262   195   187   206   243   201   190   179   179   150   125   121    96    67    71    52    40    36    36    38    24    12
M:f22=   492   873  1270  1406  1049   557   352   281   293   305   310   266   234   259   267   222   207   171   152   125   117   124   111    93    91    66    50    47    49    48    31    16
M:f23=   814  1437  1629  1947  1531   666   418   340   355   315   349   369   345   329   261   225   224   178   142   109   122   129   116   125   114    88    80    64    62    61    40    22
M:f24=  1103  2015  2193  2970  2137   816   526   473   506   421   509   486   480   405   278   248   249   225   176   140   141   135   131   158   147   131   124    91    88    88    55    33
M:f25=  1215  2304  3049  4586  3012   973   722   714   711   661   829   608   523   405   287   289   322   323   257   222   179   161   194   220   207   195   176   129   133   130    81    48
M:f26=  1202  2861  4088  5698  3567  1012   867   906   952  1013  1097   733   513   352   284   358   464   482   382   369   262   252   330   337   297   270   243   192   179   162   106    61
M:f27=  1692  3945  4978  5726  3427   893   775   923  1093  1218  1081   731   502   394   351   445   628   732   577   586   405   437   516   481   421   367   299   263   248   200   124    79
M:f28=  3428  4611  6013  6285  3599   883   731  1024  1164  1418  1153   719   516   513   543   565   807  1059   830   791   549   632   668   614   557   452   349   317   349   282   146    97
M:f29=  6270  5873  8179  7200  3957  1145   965  1395  1737  2134  1536   855   663   639   762   756  1113  1595  1225   983   714   817   814   673   573   450   403   404   446   355   166   105
M:f30=  9754  9622 11394  7165  4522  2175  1524  2165  2896  2947  1902  1066   893   830   948   934  1443  2246  2014  1453  1080  1073  1003   695   466   385   471   517   487   369   204   128
M:f31= 13520 15729 15559  7632  6648  4740  2698  3354  4341  3500  2201  1344  1043  1018  1095  1059  1805  2799  3242  2339  1587  1295  1095   675   317   315   525   557   425   331   251   187
M:f32= 15274 23192 21914 10788 11365  9077  5307  4776  5807  3976  2625  1708  1151  1200  1387  1756  2922  3657  4269  3481  2313  1409   825   465   161   207   414   451   340   289   266   227
M:f33= 13520 26471 25550 15241 18222 15080 10203  7315  7471  4865  3160  2005  1326  1568  2126  3210  4680  4528  4170  3876  2687  1273   441   202    62    92   211   307   320   276   245   176
M:f34=  9754 21874 22408 17097 22023 19192 16351 12855 11468  7592  4160  2636  2145  2913  3740  4692  5560  4499  3363  2929  1955   825   194    64    26    34    99   235   324   273   218   116
M:f35=  6270 15310 16602 15558 19843 18169 19653 18327 16854 11037  5469  4241  4229  5146  5376  5022  4785  3691  2351  1622   952   415    84    22    17    18    56   191   289   237   211   110
M:f36=  3428  9683 12461 12216 15018 13796 16298 18613 17631 10864  6094  6075  6527  6463  5080  3520  2864  2397  1243   674   375   171    40    15    15    16    36   163   246   176   178   103
M:f37=  1692  5905 11128 10153  9887  8186  9553 13447 12424  7651  5677  6779  7882  7002  3872  1817  1248  1158   474   212   126    64    24    16    16    18    31   136   175   119   114    68
M:f38=  1202  4727 11416 11332  6377  3700  4043  6282  5638  4052  4089  5560  6861  5684  2461   776   450   449   161    64    42    31    19    16    16    18    27    87    93    64    53    32
M:f39=  1215  4582 11578 12064  4531  1380  1280  1967  1806  1531  1950  2962  3602  2693  1117   307   172   177    65    28    22    22    18    14    15    17    19    37    35    25    21    16
M:f40=  1103  4033 10911 10304  2914   545   423   572   558   463   597   958  1075   770   369   128    84    80    33    19    16    18    18    13    15    18    17    17    17    15    14    10
M:f41=   814  3225  9611  8782  1958   260   208   227   195   151   155   230   224   179   115    60    50    38    23    20    16    17    17    13    15    18    16    15    16    14    13     9
M:f42=   492  2421  7508  7183  1576   130    97    97    79    64    65    76    66    62    51    37    34    24    22    20    19    18    17    14    14    16    14    13    14    12    12     8
M:f43=   290  1436  4351  4426  1007    58    41    42    38    38    43    39    36    41    34    29    25    21    23    21    21    20    18    16    15    15    13    12    12    12    13     7
M:f44=   177   675  2171  2315   502    33    25    28    32    33    33    26    26    33    29    25    23    21    22    22    23    22    20    19    16    16    13    11    11    13    14     8
M:f45=    98   318  1386  1407   254    30    24    24    31    31    27    21    22    27    26    24    23    20    19    22    24    23    20    20    15    14    13    12    11    14    12     7
M:f46=    48   149   828   804   135    27    23    21    27    29    25    22    23    23    24    25    23    18    18    23    24    23    18    18    13    11    12    14    12    13    11     7
M:f47=    24    60   332   325    67    25    22    19    25    29    25    24    26    25    27    27    26    22    19    25    25    21    17    16    12    11    12    14    13    11    11     7
M:f48=    15    21    96   101    35    27    24    19    22    29    26    25    28    27    30    27    25    23    19    23    23    19    15    15    12    11    13    14    13    10    10     8
M:f49=    12    10    33    38    23    27    25    18    20    28    24    21    25    25    25    21    19    18    19    22    21    19    16    16    12    10    12    14    13    10     9     7
M:f50=     9     8    19    24    22    26    23    20    24    29    25    19    21    20    19    18    16    17    20    23    22    21    18    17    13     9    11    14    14    11    10     7
M:f51=     7     7    14    22    26    27    23    22    27    31    27    18    21    20    18    18    18    17    20    25    23    21    20    16    14    10    12    14    12    11    11     6
M:f52=     5     7    12    20    27    28    26    27    28    31    28    20    23    24    21    18    18    14    19    26    22    20    20    16    13    11    11    13    12    13    13     7
M:f53=     4     6    11    17    24    26    26    28    29    33    29    26    27    24    20    19    20    14    19    23    22    20    18    16    14    13    13    14    14    13    13     8
M:f54=     5     8    13    19    24    23    24    26    30    33    31    30    27    22    20    22    23    17    18    20    20    20    18    16    16    15    14    15    14    14    10     8
M:f55=     4    10    15    21    26    23    23    26    28    30    33    32    25    20    22    25    25    20    20    19    17    19    18    16    18    16    13    14    13    12     9     6
M:f56=     3     9    15    21    25    22    22    22    22    25    32    34    27    22    23    24    24    21    23    21    18    19    16    14    17    17    14    15    12    11    10     6
M:f57=     3    10    19    25    24    21    22    20    21    24    31    35    31    26    22    22    24    22    26    24    20    19    14    13    16    17    14    17    12    11     9     6
M:f58=     3    11    24    30    26    22    23    23    22    22    28    28    30    29    22    19    24    24    26    25    21    17    14    15    17    17    14    17    12     9     8     6
M:f59=     3    10    24    31    26    23    23    25    24    20    25    23    26    29    21    18    21    22    24    24    21    17    15    17    18    18    15    16    12    10     8     6
M:f60=     4     9    21    28    25    22    21    26    26    21    25    24    25    28    21    21    21    20    20    20    19    17    16    18    17    17    16    15    11    10    10     6
M:f61=    39    25    18    24    24    20    18    24    29    25    25    25    27    27    22    23    21    20    19    18    17    17    16    18    18    16    17    15    10    10    11     6
M:f62=   541   254    29    20    24    21    18    24    30    28    22    24    29    28    22    22    21    19    19    16    15    16    16    17    16    16    18    14    10    11    10     6
M:f63=  2780  1279    95    32    23    21    18    22    24    23    19    23    27    27    21    18    18    19    18    15    15    14    14    14    12    12    14    11     9    10     8     4
```

6.5 Removing of the Software

If you want to remove the program from your PC you must be logged in as administrator. If still active you must stop the MRR-2 data-, error- & communication service using the `services` program in the program group `control panel/Administrative Tools`.

Then activate the folder `software`, select the entry `METEK MRR Software` and press the button `Add/Remove`. Finally you must manually remove the empty directory (`C:\METEK`) and possibly some data files and directories.

7 Detailed description of the MRR-2 control program

The MRR-2 generates Doppler spectra at 31 height ranges. The data processing is performed by a DSP which is located in the Radar Control and Processing Device (RCPD) at the antenna. The measured data are transmitted by a serial RS-232 port. This port is also used for the device control. If the MRR-2 is connected to a PC, the control, the calculation of further values, and the recording of the data can be done with the MRR-2-control program described below.

The software is divided into two components :

- Communication-, Data-, and Error- Service (CDES)
- Control Program User Interface (CPUI)

DCES communicates directly with the connected MRR-2, and CPUI performs the operational control of the MRR-2 using CDES. By means of this the user can interrogate or change the system status in a comfortable way.

Windows® Service Programs

Service programs are software components, which are started automatically when the machine is turned on and the operating system boots. They offer their ‘services’ e.g. control functions and data to other programs. The management of those programs must be provided by the operating system. The starting of a service program needs no manual operation. Only take care that the corresponding service is not deactivated.

Various details of the usage of services depend on the operating system. For this reason the used operating system must be Windows® 2000 or XP. (Windows® Vista and Windows 7 are not supported).

7.1 Communication-, Data-, and Error-Service (CDES)

7.1.1 Communication Service

This service is needed for the communication between the control program user interface (CPUI) and the control port of the MRR-2, which is implemented as a serial interface. With CDES the system settings of the MRR-2 can be retrieved and any changes entered by the user are translated to the corresponding commands and transmitted to the MRR-2. (Factory setting of the serial port of the MRR-2 is 57600 baud, 8 bit, no parity, XON/XOFF handshake protocol.)

7.1.2 Data Recording

The second function of CDES is the recording of the “averaged” or “instantaneous” measured data of the MRR-2. The data is ASCII formatted, so that it is directly readable.

CDES creates one file each day, whose name is constructed from the actual month, the day (2 characters each) and an additional extension. The boundary between two days is defined as 0:00 (selected time zone including UTC). The file name extension is `.MRR` .

All files of a month are stored in a separate directory which will be created automatically if it is not already existing. The names of the directories are constructed from the actual year (4 digits) and the respective month (2 digits).

The path names for the data registration and the port settings may be changed with the MS registry editor regedit.exe at the key

```
HKEY_LOCAL_MACHINE\
   System\
      CurrentControlSet\
         Services\
            MrrSrvc\
               Parameters
```

The variables of this key are shown with their default settings. Change the underlined values, if necessary :

```
Port                    REG_SZ         COM2
BaudRate                REG_DWORD      57600
AveragedDataFile        REG_EXPAND_SZ  %MetekRoot%\ActData\Data%s
AveragedDataPath        REG_EXPAND_SZ  %MetekRoot%\Data
InstantaneousDataFile   REG_EXPAND_SZ  %MetekRoot%\ActData\InstData%s
InstantaneousDataPath   REG_EXPAND_SZ  %MetekRoot%\InstData
```

The common root directory is defined by the environmental variable

`MetekRoot`

It also can be changed with the registry editor at the following key :

```
HKEY_LOCAL_MACHINE\
   System\
      CurrentControlSet\
         Control\
            Session Manager\
               Environment
```

The variable is :

`MetekRoot` `REG_SZ` **`C:\METEK`**

The default settings are :

`C:\METEK\Data`	for averaged data
`C:\METEK\ActData`	for actual data(raw, instantaneous and averaged)
`C:\METEK\Instdata`	for instantaneous data
`C:\METEK\Rawdata`	for raw data, not processed, only for testing purposes
`C:\METEK`	as the common root directory

The file `C:\METEK\Data\200506\0611.MRR` e.g. would contain the averaged data from June, 11th of 2005.

7.1.3 Error Protocol

The third function of CDES is the recording of all error messages which are caused by the operation of the MRR-2 (except messages which are generated from user input errors).

The error recording is done by the event logging function of the operation system. At the item `application` you find a chronologically sorted list of error messages, which occurred during the operation. Use the Windows event viewer to look at the messages or to store them in other formats. You also can define, how the system shall act if more than the storable number of errors occur. The event viewer is located in the program group `Programs/Administrative Tools.`

7.2 Control Program User Interface (CPUI)

CPUI provides the user access to the MRR-2 through CDES. The correct installation and the automatic start of the service program are required for a successful start of CPUI. CPUI allows controlling the MRR-2 also by PCs which are not connected directly to the MRR-2.

It is only necessary that there is a network connection to that PC, on which CDES was started. This network connection may be either a local connection (ethernet) or a remote access connection (RAS) which is built up using the public telephone. (Make sure that you have purchased the required number of program licenses.)

For this remote operation a login at the remote CDES is necessary when you start the program (e.g. by a mouse click on a program icon you created before, or by the command line `C:\METEK\MrrCtrl`). This ensures that only one user is accessing the MRR-2.

There are no special network installations needed, because no network protocol dependent functions are used between the service and the user interface.

The following picture shows an example for a remote access, where the network connection is performed by a RAS connection. The communication of the user interface on PC #2 with the MRR-2 uses the network and the communication service program on PC #1. The data recording and the event logging is executed on PC #1 which is connected directly to the MRR-2:

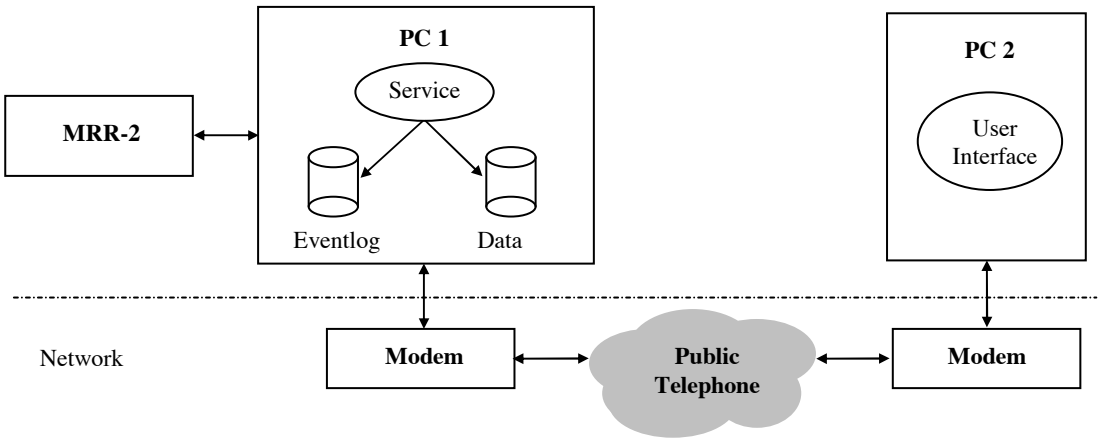

Figure 17 Remote Acces

The software is supplied on a CD-ROM with the following files:

`MrrSrvc.exe`	the service program
`MrrCtrl.exe`	control program (GUI)
`Messages.dll`	used for error messaging
`MFC71.dll`	used for runtime environment
`msvcr71.dll`	used for runtime environment
`Mrr`***`XXXXXX`***`.inf`	installation file (***XXXXXX*** stands for the serial number of the MRR)
`MrrCtrl_D.hlp`	help file German
`MrrCtrl_E.hlp`	help file English
`MrrCtrl_D.cnt`	help file German
`MrrCtrl_E.cnt`	help file English
`MrrView.bat`	
`sbsize.exe`	
`setcolor.exe`	
`gzip.exe`	data compression tool
`tail.exe`	data viewer

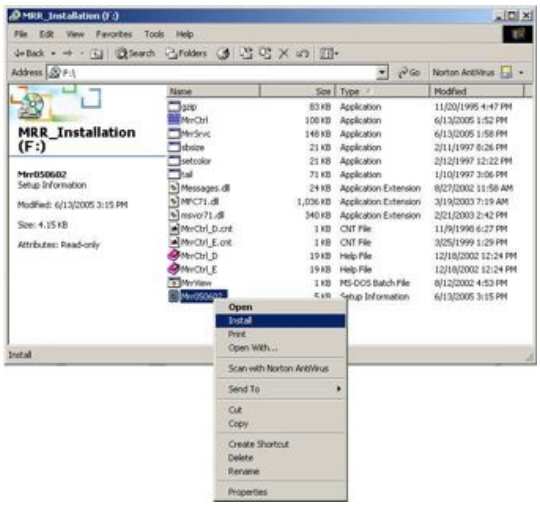

Figure 18 Directory Listing of the Installation CD-ROM

After installation of the MRR software the port settings may be changed with the MS registry editor regedit.exe at the key

```
HKEY_LOCAL_MACHINE\
   System\
      CurrentControlSet\
         Services\
            MrrSrvc\
               Parameters
```

The port variables of this key are shown with their default settings. Change the underlined values, if necessary :

Port	REG_SZ	**COM2**
BaudRate	REG_DWORD	**57600**

(You must be logged in with administration rights to change Windows® Registry parameters)

Every time when you change one ore more MRR parameters in the Windows® Registry you have to restart the MRR service because these parameters are only read from the Registry when the service starts.

Open the `Start/Settings/Control Panel/Administrative Tools/Services` menu in Windows® 2000. After selecting the MRRService, stop and start it directly with the short cuts or open the **Properties menu** and use the **Stop** and **Start** buttons.

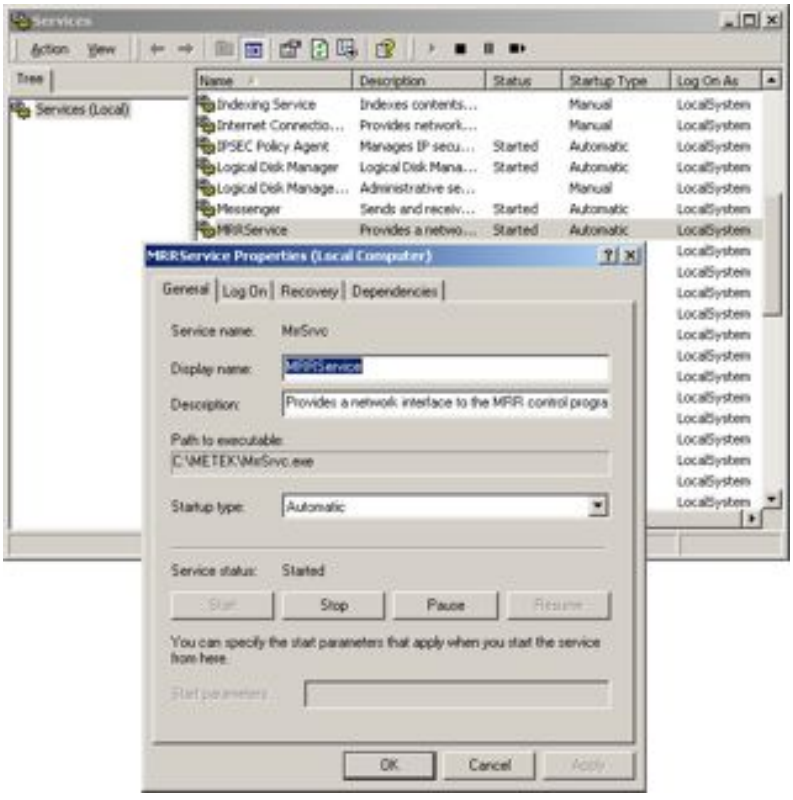

Figure 19 Administrative Tools / Services – Menu (Windows® 2000)

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CERTIFICATE
EXPERT OPINION

Registration-No.: **E814169R-EO**

Certificate Holder: **METEK**
Meteorologische Meßtechnik GmbH
Fritz-Straßmann-Str. 4

D-25337 Elmshorn

Product Designation: **Mikro-Regen-Radar (MRR) / PreWeS24**

Product Description: **Radar System**

Product Manufacturer: **METEK**
Meteorologische Meßtechnik GmbH
Fritz-Straßmann-Str. 4

D-25337 Elmshorn

Essential requirements	Specifications / Standards	Submitted documents	Result
Radio spectrum (R&TTE, Article 3.2)	EN 300 440-1 V1.3.1 (2001-09) EN 300 440-2 V1.1.1 (2001-09)	Test Report	conform

Marking: **The product shall be signed with CE, our notified body number and the Class II identifier (Alert sign) as shown right hand.**

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Number of annexes: **1**

Saarbrücken, 18.10.2004
Place, Date of Issue

Signed by Ernst Hussinger
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CETECOM ICT Services GmbH

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